

Advanced Research for Landfill System Methane Mitigation

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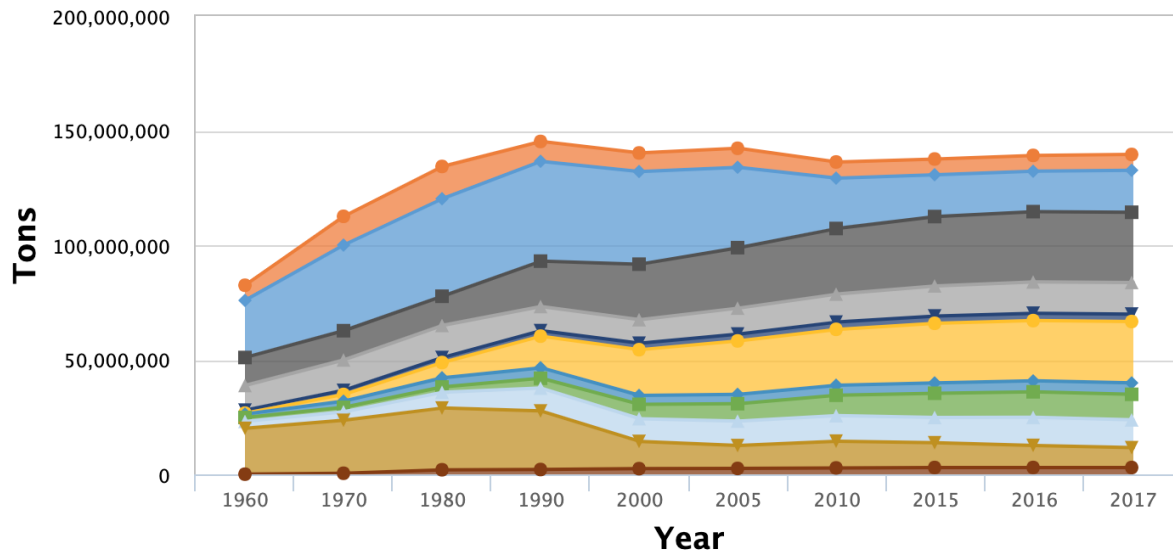
REMEDY Workshop
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WASTE MANAGEMENT AND LANDFILLS

Waste, organic waste, and their eventual fate

140 million tons of waste goes to landfills annually and nearly half of this waste is organic.

Landfill Tonnages, 1960–2017

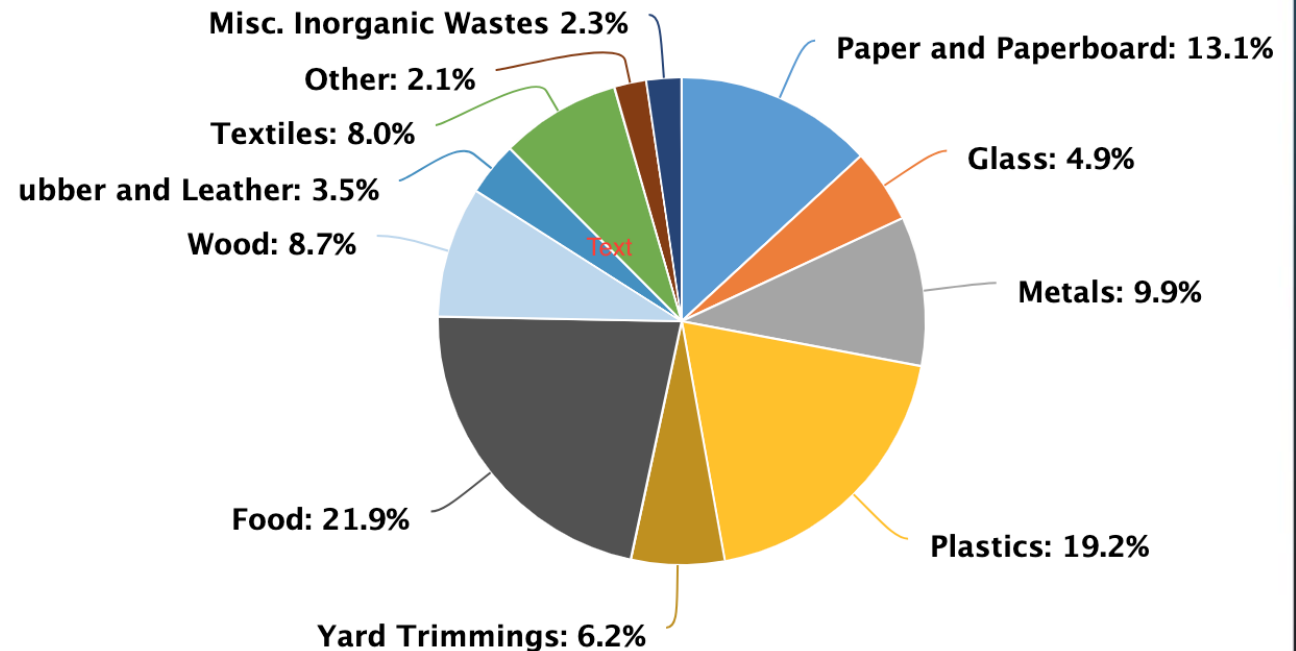


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Total MSW Landfill by Material, 2017

139.6 million tons



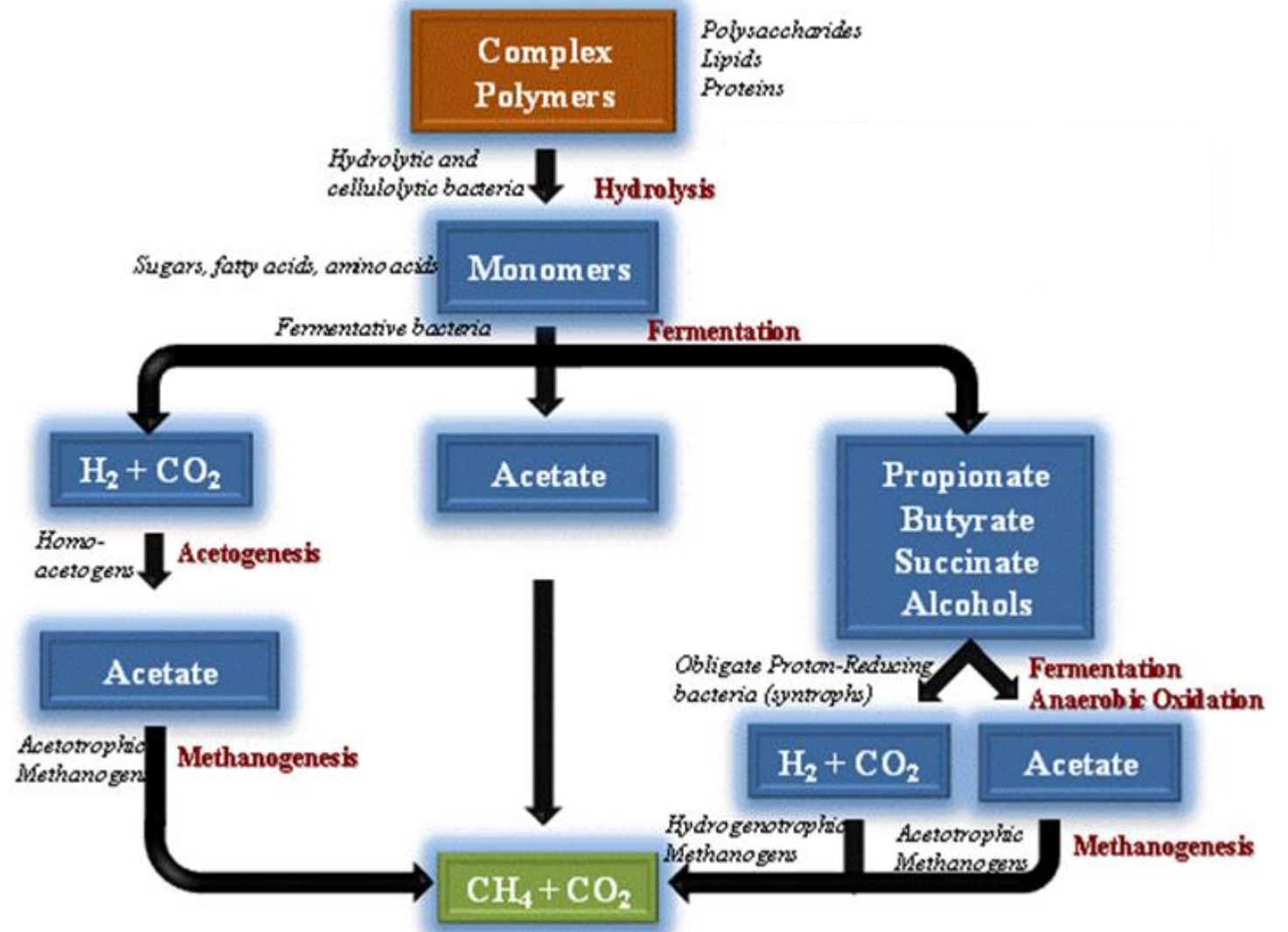
LANDFILL EMISSIONS AND EMISSIONS DRIVERS

Anaerobic Digestion Process

Complex, heterogenous, and dynamic feedstocks



Simple, pure, and consistent products



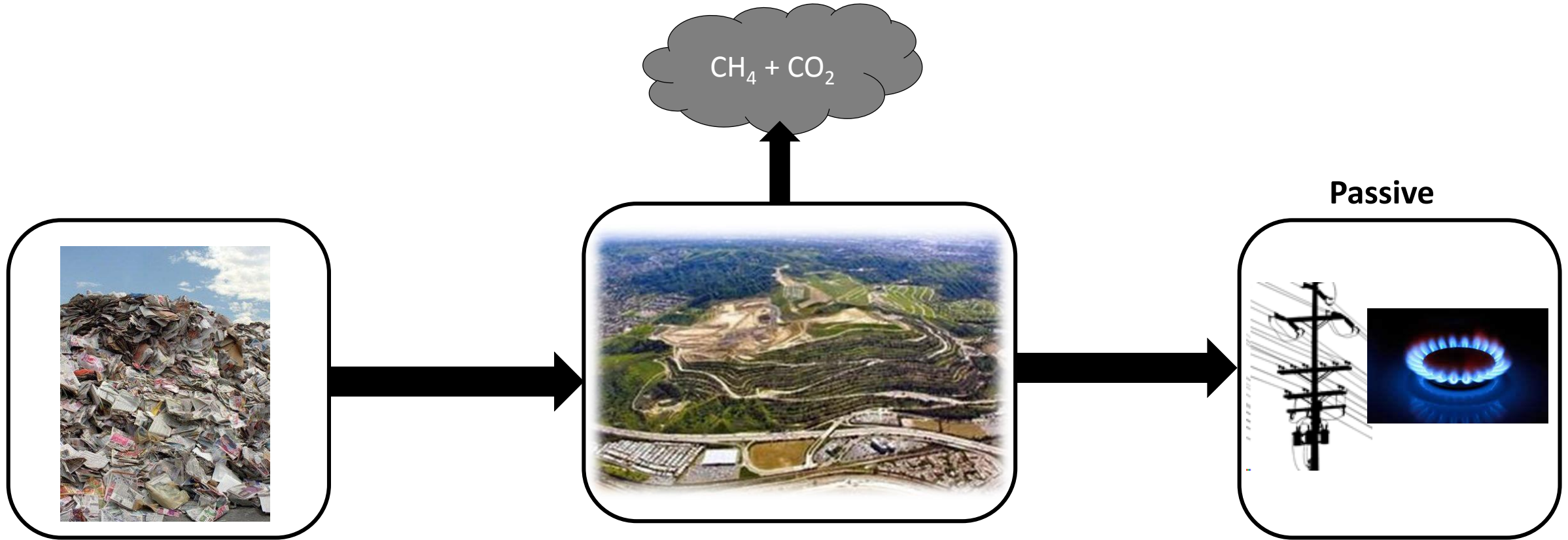
Design objectives matter

When the goal is managing waste.....



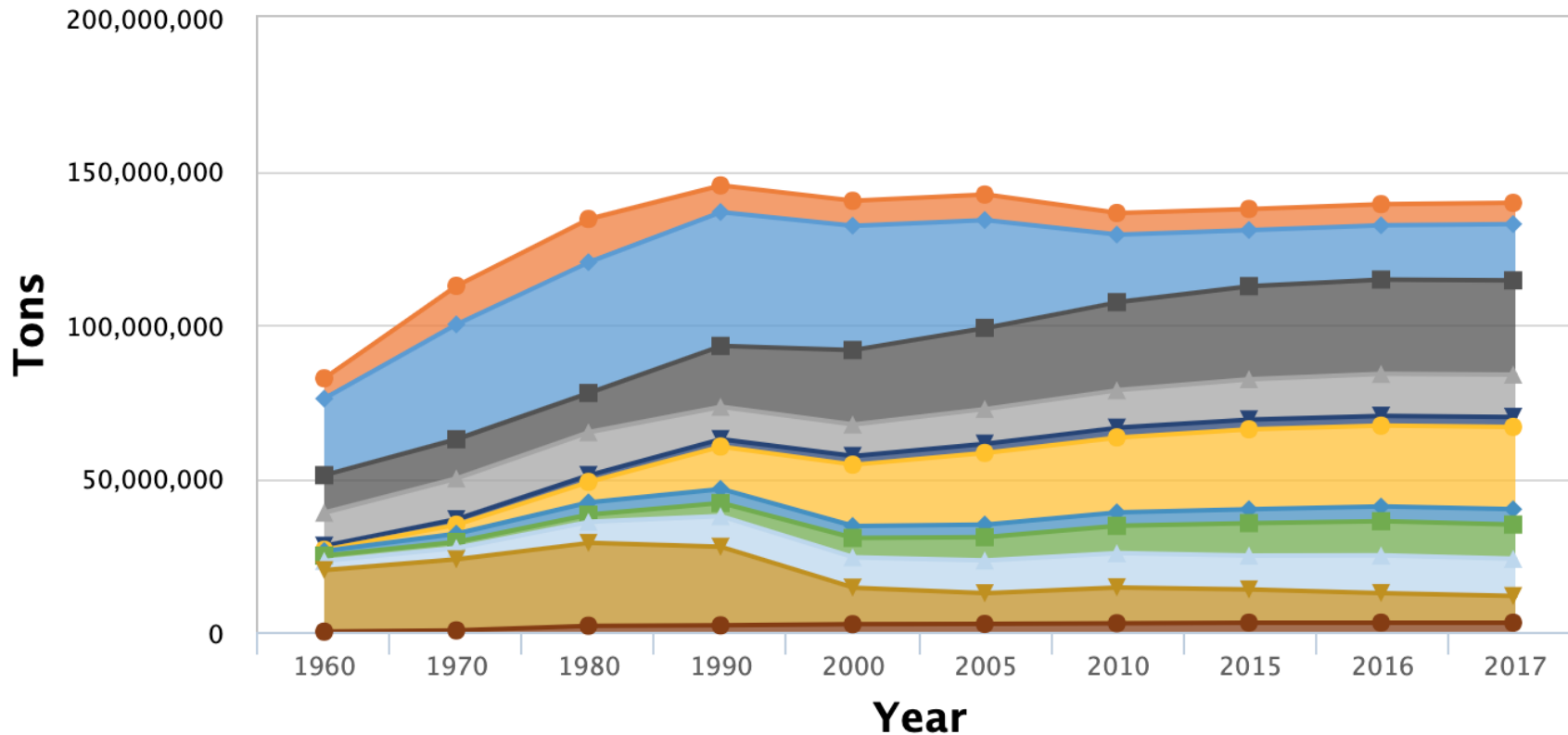
Design objectives matter

When the goal is isolating waste.....



Waste recalcitrance prolongs emissions window

Landfill Tonnages, 1960–2017

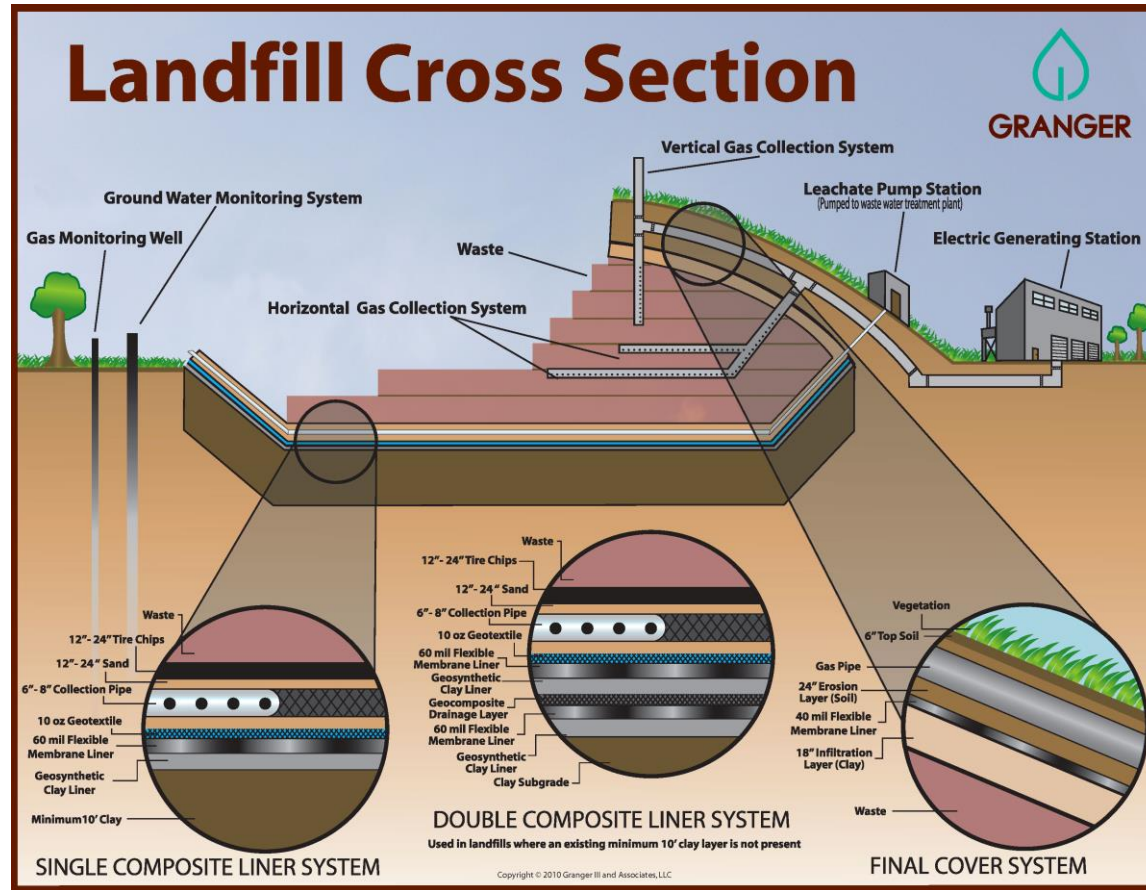


Click on legend items below to customize items displayed in the chart

Glass Paper & Paperboard Food Metals Misc Inorganic Waste Plastics
Rubber & Leather Textiles Wood Yard Trimmings Other

- Traditional dry-tomb landfills inherently prolong waste stabilization
- Barlaz studies found that more than 90% of landfill biogas is derived from cellulose and hemiscellulose
- Reducing and redirecting new organic waste from landfills will have no effect on the in place waste susceptible to anaerobic degradation

Waste management is dynamic, landfills are inflexible

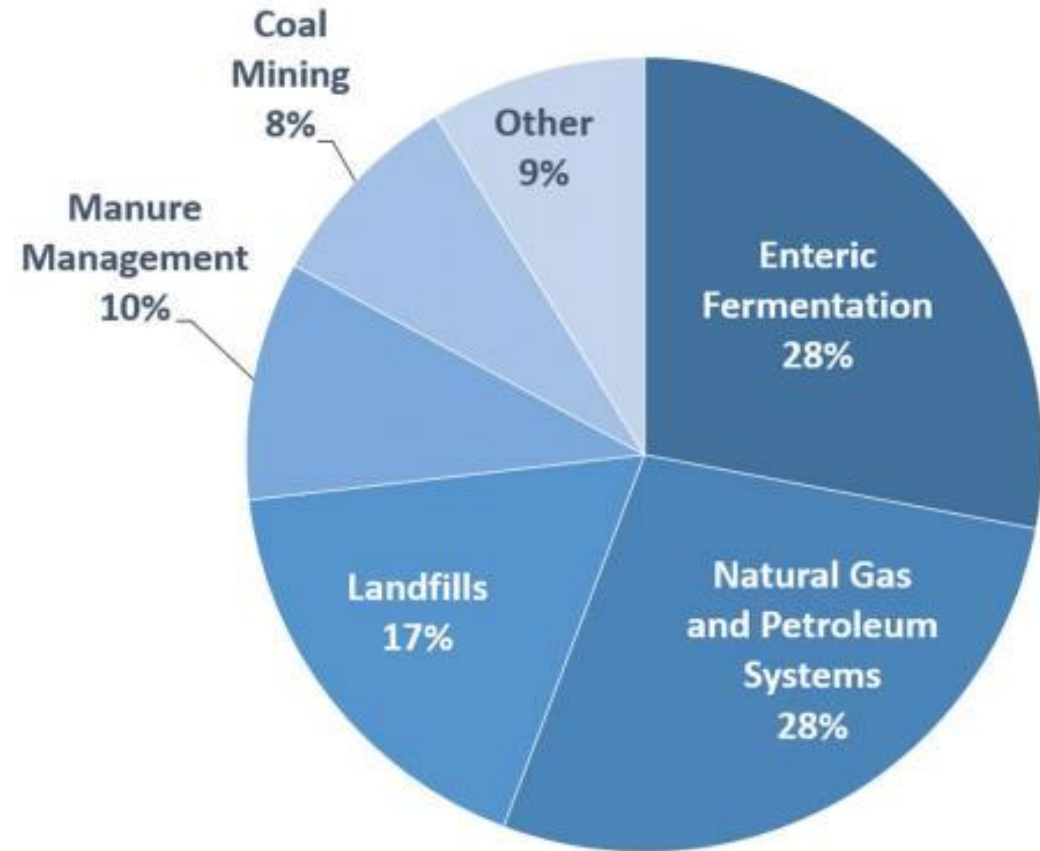


Waste stabilization kinetics cannot be optimized in landfill systems, which allows for substantial uncertainty in predicting and managing biogas generation.

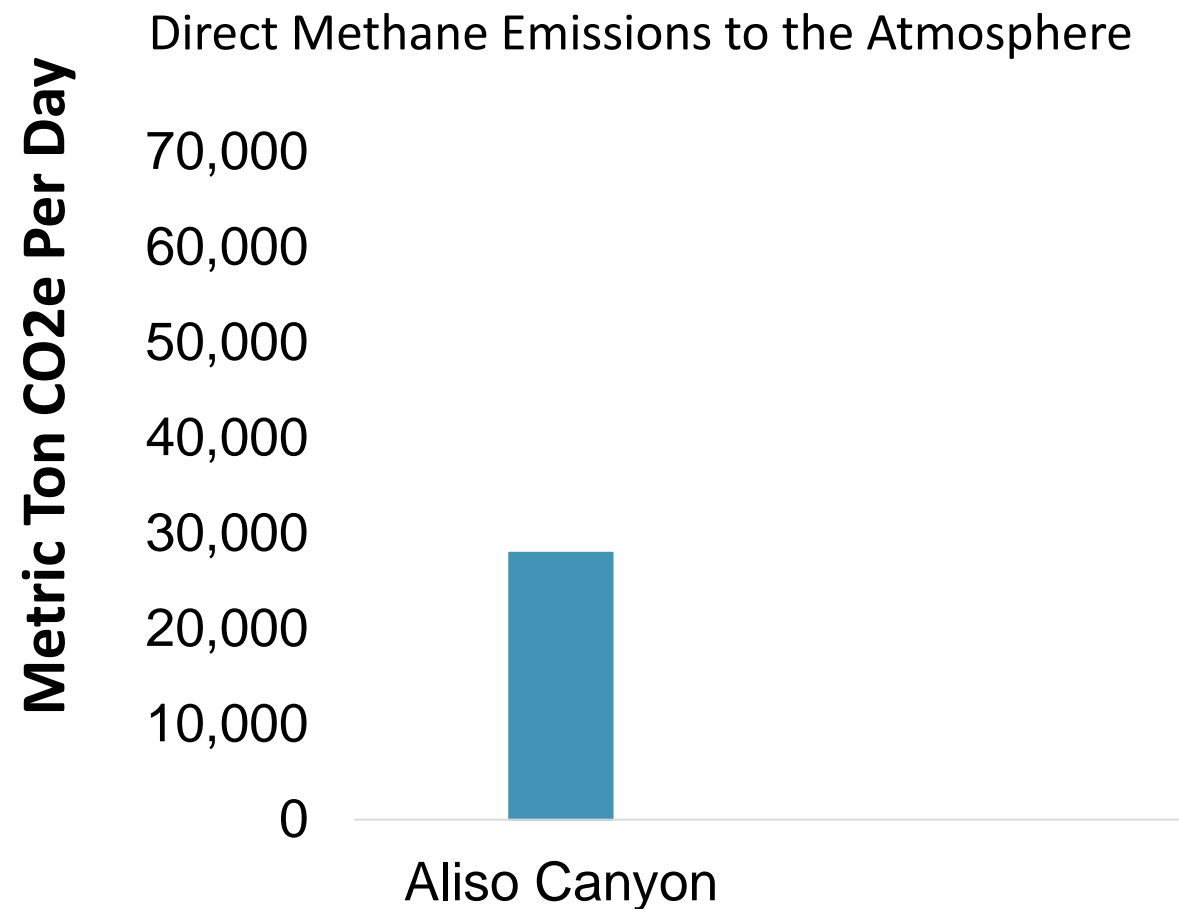
Landfill emissions

650 M MT CO₂e
per year in the
United States

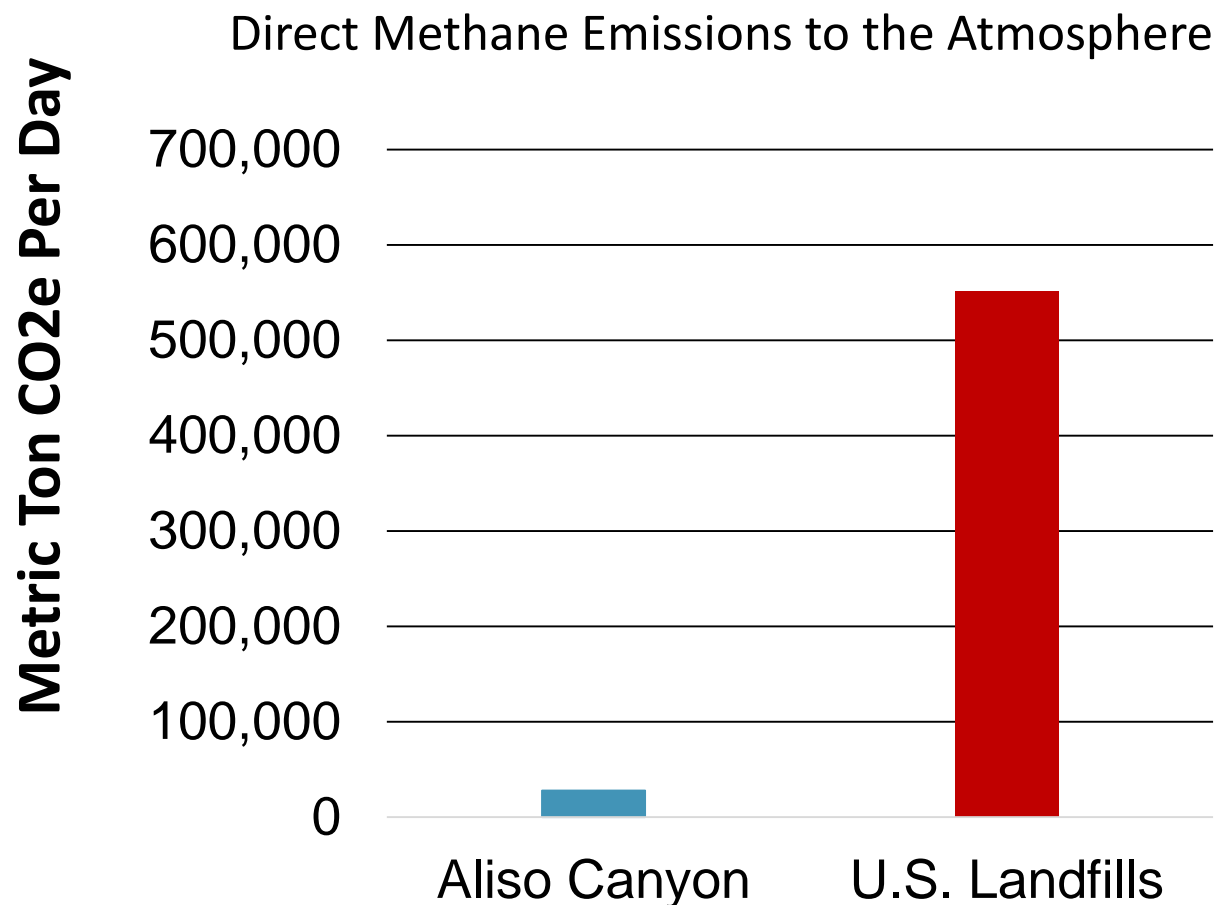
2018 U.S. Methane Emissions, By Source



Methane emissions from Aliso Canyon natural gas leak



The climate cost of landfilling

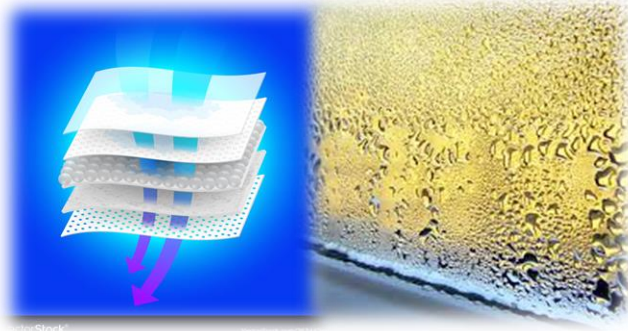


U.S. landfills emit nearly 20 times more methane than Aliso Canyon did each day

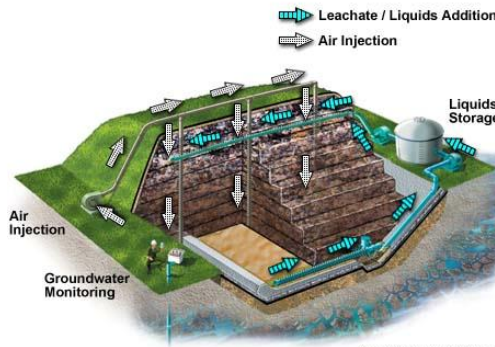
MITIGATING LANDFILL METHANE EMISSIONS

Advanced research areas for methane mitigation

Engineered solutions designed to optimize for CH₄ mitigation

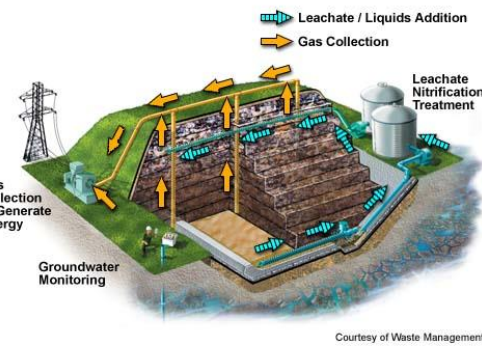


Moisture Control



Courtesy of Waste Management

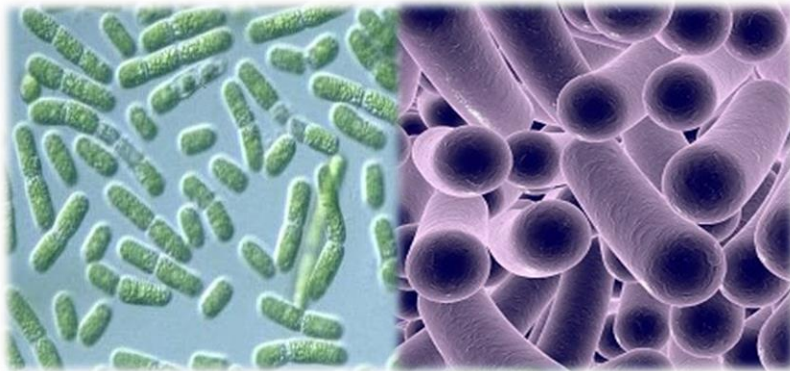
Aerobic/Anaerobic Control



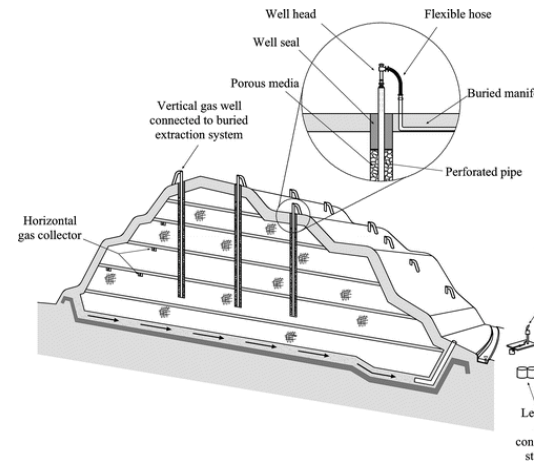
Courtesy of Waste Management



Biogas Collection Systems



Cover Soil Microbe and Consortia Engineering



Systems Approaches

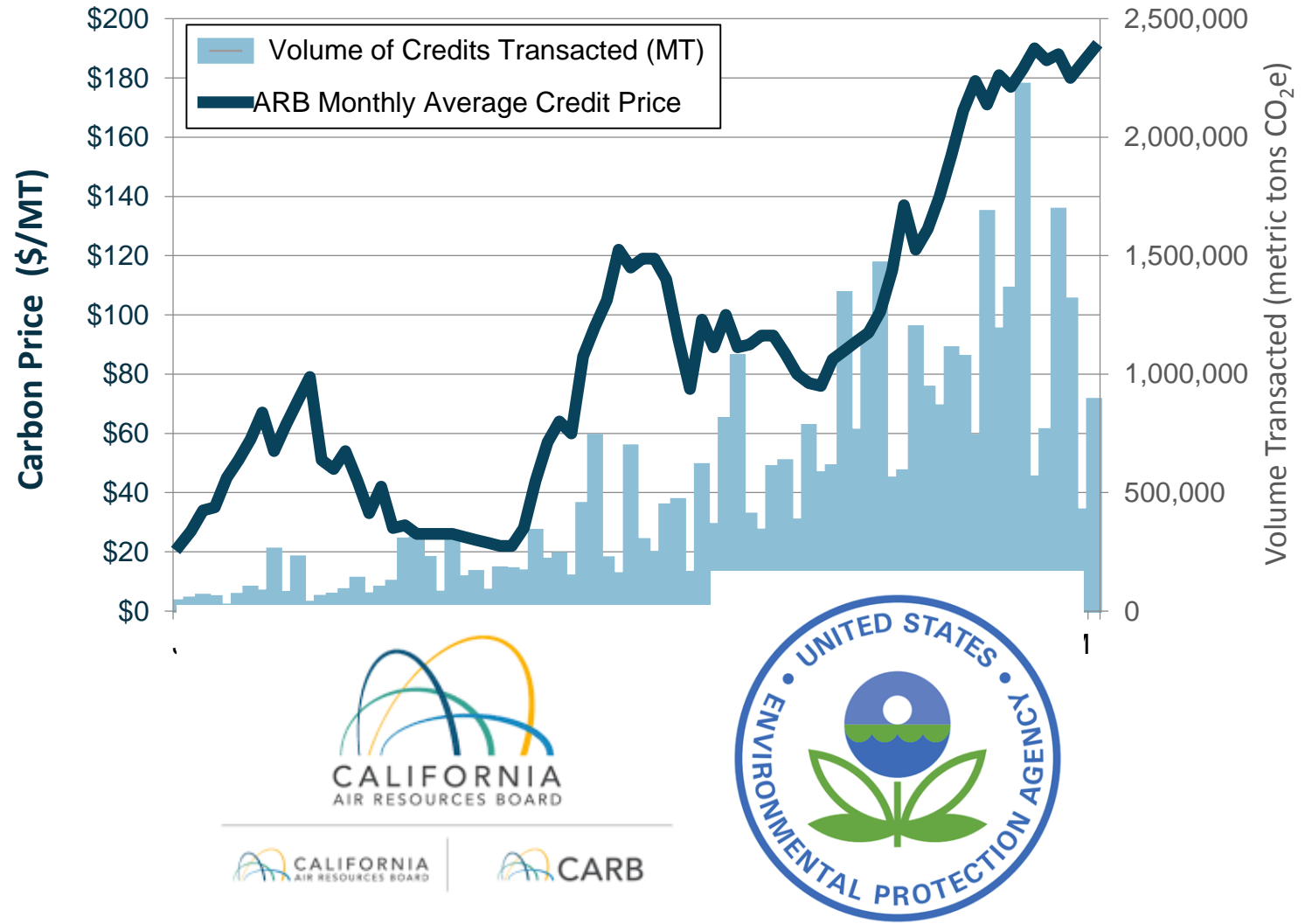


RESEARCH METRICS CONSIDERATIONS

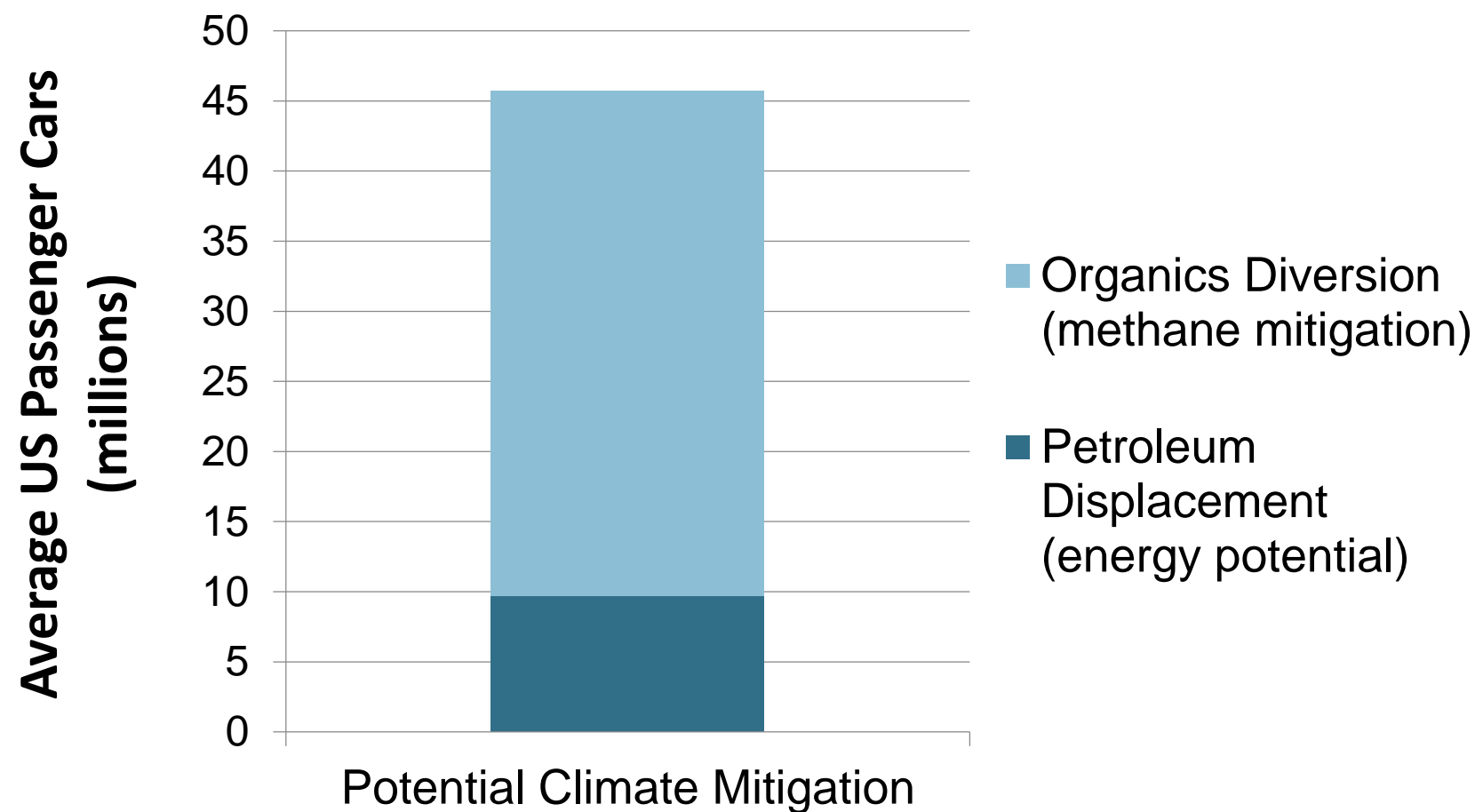
Research metrics to be matched to carbon mitigation goals

► Policy

- Policy needs to drive decision making towards optimization for GHG mitigation as opposed to allowing perverse incentives to remain when making decisions to maximize profits
 - Research metrics therefore need to be matched with policy targets to offer the lowest cost options for achieving maximal GHG reductions



Energy versus Carbon



Environmental Protection Agency (EPA). 2016. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014. EPA 430-R-16-002. April 15, 2016. Washington, DC

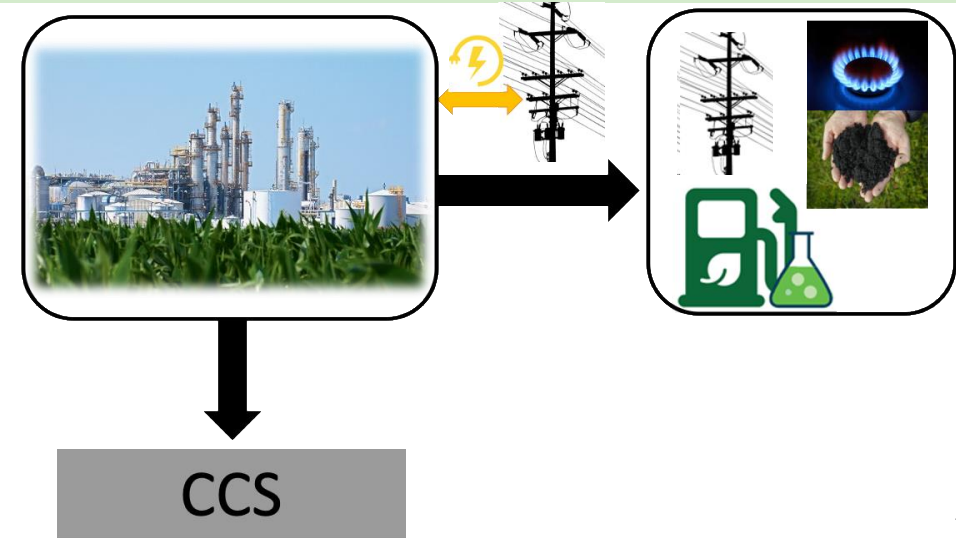
ANCILLARY POSSIBILITIES

Potential to transform the *circular economy*

Wastes and Heterogeneous Feedstocks – Carbon Circularity



Carbon Valorization Refining

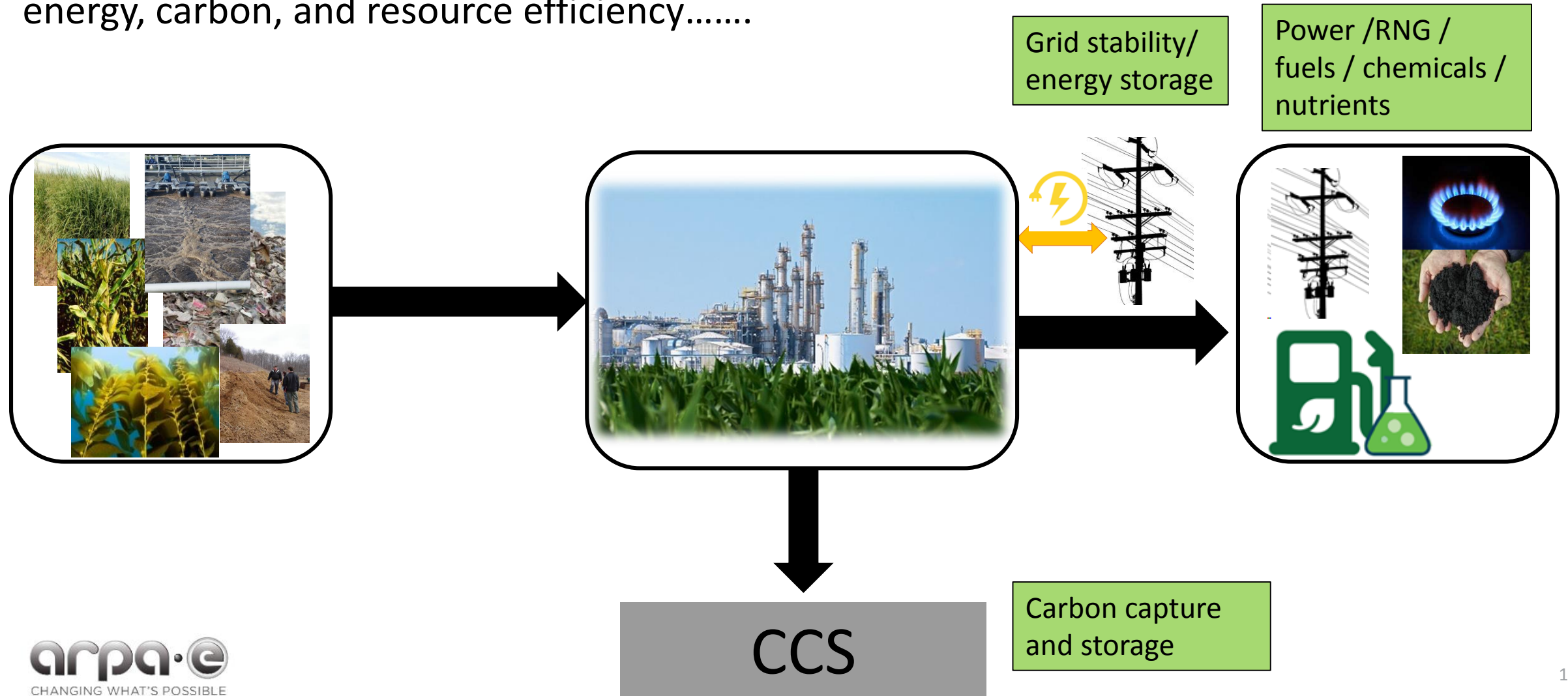


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Redesigned AD Biorefining
*Maximize carbon efficiency, and
profitability for a circular economy that
values carbon utility.*

Design for multi-parameter value optimization

When the goal is sustainability and circularity as well as simultaneously optimizing energy, carbon, and resource efficiency.....



Thanks for having me!

Contact me

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